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AI vs. AU in American English compared to German

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Abstract

American English and German AI, AU observed in cognates such as *Wein, wine, Haus, house* are usually treated on a par, represented with the same initial vowel (cf. [aɪ], [aʊ] for Am. Engl. and German [1]). Yet, acoustic measurements indicate differences as the relevant trajectories characteristically cross in Am. Engl. but not in German. These data may indicate consistency with the same initial target for these diphthongs in German, supporting the choice of the same symbol /a/ in phonemic representation, as opposed to distinct targets (and distinct initial phonemes) in American English.

Index Terms: corpora, phonetics, phonology, diphthongs

1. Introduction

Phonemic theory is rooted in the intuition of a single level of abstraction, where speech sounds have identical representations for as long as phonetic differences between them can be attributed to context [2]. The question arises then of what the conditions are for determining whether or not phonetic differences can be attributed to context.

Diphthongs, which are defined by a movement from a starting position to a different finishing position within the syllable, appear to be particularly prone to coarticulation among its two members. Here we focus on the initial member of AI- versus AU-type diphthongs in words like *wine, house* in American English and *Wein, Haus* in German. In both languages the F1/F2 trajectories indicate distinct turning points associated with the respective initial members towards the positions associated with the following members (assumed to be /i/ versus /u/, respectively). We suggest that the relevant differences among those turning points for German can be attributed to the distinct position associated with the second diphthong member, whereas such an analysis seems highly questionable for the respective turning points in American English. Independent phonological evidence for the sameness of the initial members of AI and AU in German, as opposed to English, as well as additional allophonic relations of those members to independent monophthongs will also be discussed.

2. Data

The data were taken from two corpora of read speech [3], [4]. (TIMIT American English, Northern, 31 female speakers, Southern, 36 female speakers, Kielcorpus, Standard German, 26 female speakers), manually annotated. Formant values were extracted automatically with PRAAT [5] at 10 equidistant points between 5-95% of the acoustic vowel duration, Burg algorithm, 5 formants, with 5500 Hz as maximum formant search range. The contexts for the target vowels were not checked but considered to be fairly representative for a wide range of occurrences. The examples we use here in the text are not necessarily contained in the corpora.

3. Discussion

The trajectories for the German diphthongs AI and AU in Figure 1 indicate distinct turning points marking the respective targets of the initial diphthong members (cf. also [6]). The further back articulation of the initial vowel in AU compared to that in AI can be explained with reference to context, indicative of anticipatory retracting (as well as raising) of the tongue body to produce the following back high vowel. As a result of being analysable in terms of modifications of the timing of articulatory gestures conditioned by context the relevant differences qualify as allophonic, supporting the same initial phoneme in German AU and AI.

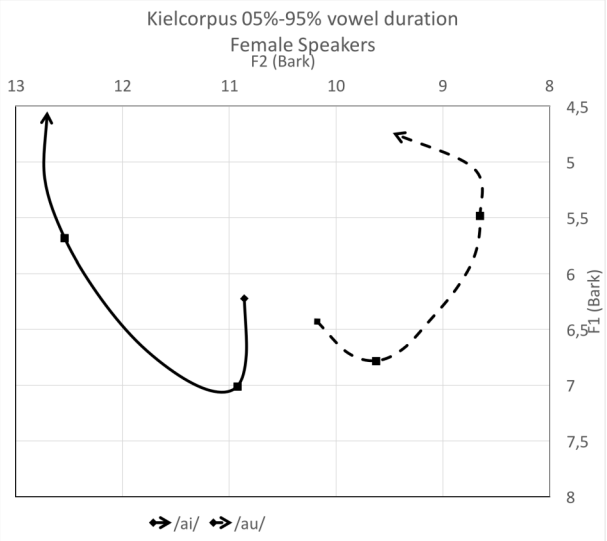

Figure 1: *Germ. AI (cont.), AU (dashed) 5% - 95% of vowel duration, square marks indicate 25% and 75% as in all the following figures, symbols indicate phonemes.*

Both the assumption that German AI and AU are biphonemic and that they share the same first vowel phoneme are supported by phonological evidence from reduplication ([7]). The data in (1) illustrate relevant word formation patterns expressing exasperation in German, where the vowel in the nucleus is repeated and the sequence is separated by /h/ (1a). The fact that for base words containing a diphthong only the initial vowel is reduplicated (cf. (1b)) indicates a biphonemic structure of diphthongs. The observation that the respective initial syllables in reduplicated words based on AI and AU are entirely homophonous in (1c) (boldfaced) supports the assumption of identical vowel phonemes to represent the

initial members in the relevant diphthongs. The observation that the bodfaced syllables are moreover homophonous to the initial syllables in reduplicated words based on the monophthong /a/ as in (1d) supports the choice of the centralized low monophthong as in *kalt* 'cold' to represent the initial diphthong member in German AI and AU.

(1a) /ja/ 'yes' -> /jaha/
(1b) /nain/ <nein> 'no' -> /nahain/
(1c) /kain/ → /**ká**.hàin/ <kein> 'no'
/kaum/ → /**ká**.hàum/ <kaum> 'barely'
(1d) /kalt/ → /**ká**.hàlt/ <kalt> 'cold'

The relation between the trajectories of German AI and AU to those representing the monophthongs as in /zat/ <satt> 'full' versus /zɑt/ <Saat> <seed> is shown in Figure 2.

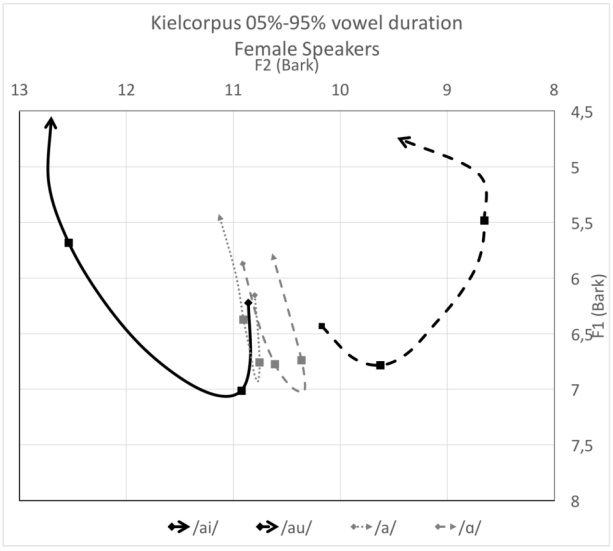

Figure 2: *Germ. AI (cont.), AU (dashed) and two vowel monophthongs.*

The data support the choice of centralized /a/ to represent the initial diphthong member in German AI and, assuming the coarticulatory influence from the following /u/ discussed above, are moreover consistent with positing this vowel as the initial member of AU. Despite the closer vicinity of the peripheral vowel /ɑ/ to the turning point marking the initial member of AU there are two reasons for positing centralized /a/ in both diphthongs. There is a general constraint against peripheral vowels in closed syllables in German, which rules out tautosyllabic /ɑu/. Also the fact that the initial vowel in both AI and AU is short in words like *Haus* and *Wein* indicates initial centralized /a/, since peripheral vowels are always subject to phonetic lengthening in stressed syllables in German.

(American) English differs from German in that the trajectories of AI and AU characteristically cross, overlapping strongly in some regions (Figure 3 Southern), less so in others (Figure 4 Northern). In contrast to German it is hence the initial vowel in the diphthong AI, which is articulated further back than that in *AU* [8, p.1572], [9, p. 162].

It is questionable whether or not this difference is consistent with positing the same phoneme for the initial diphthong member: presumably it resists explanation in terms of modifications of articulatory gestures conditioned by the relevant second members. Assuming that AI and AU in English are also biphonemic we suggest then that the phonemes representing their respective initial member differ.

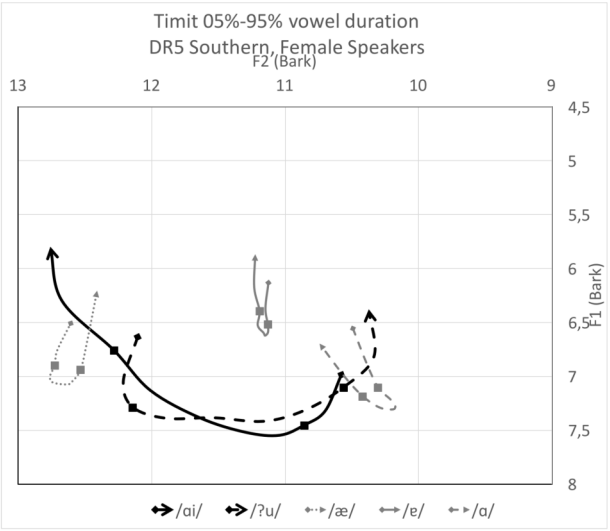

Figure 3: *Am.E. (Southern) AI (cont.), AU (dashed) and three vowel monophthongs.*

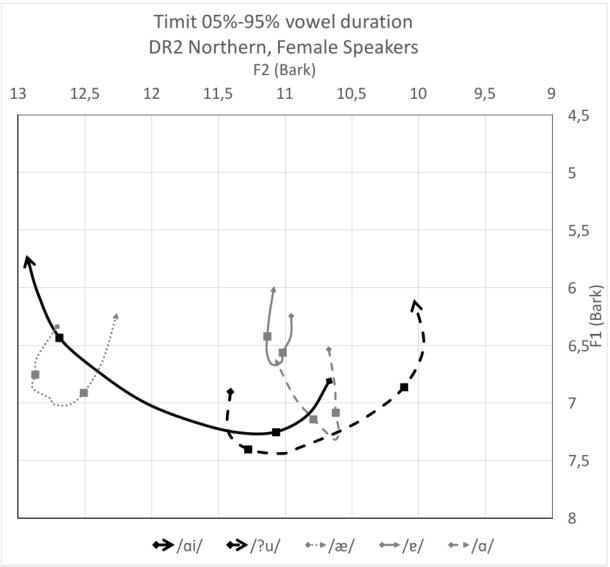

Figure 4: *Am.E. (Northern) AI (cont.), AU (dashed) and three vowel monophthongs.*

As for establishing allophonic relations to monophthongs the vowel as in *father*, transcribed as /ɑ/ in Figure 3, appears to be a plausible candidate for the initial member in AI (but not AU). AI is therefore phonemically represented as /ɑi/ in Figure 3. The allophonic relation between the initial member of AU and monophthongs appears to be much harder to establish. The vowel /æ/ (as in *gather*) might be the most plausible candidate to represent the initial member of AU in Southern Am.E., whereas /ɐ/ (as in *mother*) might be more plausible for Northern Am. E..

The latter choice is weakly supported by historical alternations (2a), which indicate the loss of the second diphthong member to reduce complex syllable structure in certain contexts, and a historical sound change (2b), which results from the loss of the second diphthong member /u/

before labials. In both cases of historical reduction of AU involving the loss of the second member, the monophthong /ɐ/ as in *mother* persists.

(2a) profound – prof/ɐ/ndity 'profundity', south -s/ɐ/thern 'southern'

(2b) pl/ɐ/m 'plum' (cf. *Pflaume*), d/ɐ/ve 'dove' (cf. *Taube*)

The initial member of the diphthong AU is represented with a question mark in Figure 3 and 4, to express our lack of certainty. In general there is a question of how to determine whether or not differences seen in phonetics can be attributed to context and therefore are consistent with positing a single phoneme.

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